**Report on experiment 02-02 763**

(14/4/2010 – 19/4/2010)

***The 3C-6H polytypic transition in SiC single crystals studied by high-resolution diffuse X-ray scattering***

The scope of the present experiment (14 shifts) was to study the polytypic transition in 3C-SiC (i) upon high-temperature thermal annealing, and (ii) upon ion irradiation. 12 (001)-oriented 3C-SiC single crystals have been analyzed (7 for part (i) and 5 for part (ii)) (5 additional 6H crystal were also analyzed for comparison). The beam energy was set to 8.333 keV.

1-The 3C-6H polytypic transition - role of temperature.

This was the main part of the experiment (~ 10 shifts). 3C-SiC single crystals have been annealed at 2000°C for increasing time (in order to obtain the transformation kinetics, figure 1) and at various temperatures for 5h (in order to obtain the activation energy of the transition, figure 2). For each crystal we recorded the extended diffuse scattering streak lying along the [10*L*] direction (*L* = 1.5 to 5.5, hexagonal coordinates). The quantitative analysis of the diffuse scattering allows to deduce the transformation mechanism, the volume fraction of transformed material and the transformation level within the transformed areas [1,2]. The diffuse scattering curves and the simulations are displayed in figure 1-2.

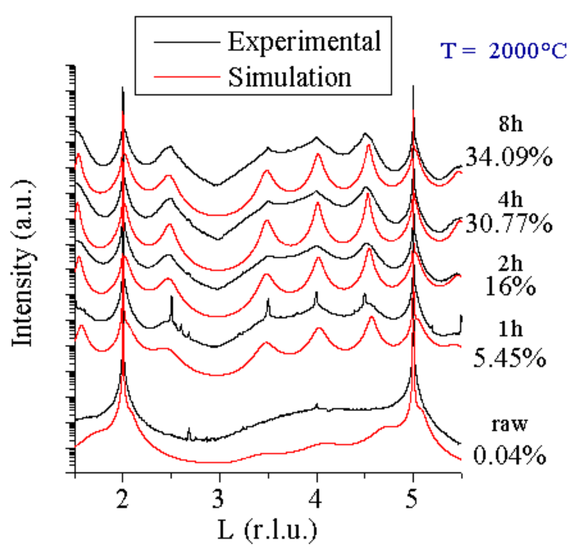


*Figure 1: influence of annealing time (T=2000°C)*

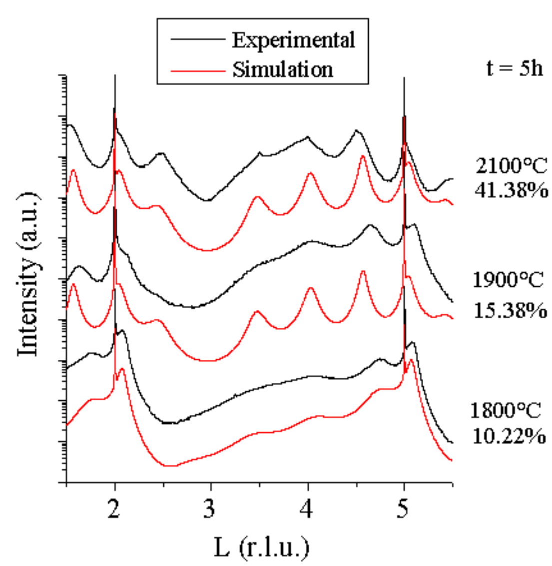


*Figure 2: influence of annealing temperature (t=5h)*

From these experiments we deduced the transformation mechanism (glide of partial dislocations) and the overall transformation level. Increasing time and temperature clearly promotes the 3C-6H transition. Both the activation energy and the kinetic exponent could be obtained from these data (this will be the topic of a forthcoming publication).

2-Role of ion implantation

Preliminary experiments (~4 shifts) were also conducted in order to investigate the stability of 3C and 6H single crystals upon ion implantation. In this experiment we recorded the [00*l*] row (with *l* close to 4 for 3C crystals and close to 12 for 6H crystals) of (001)-oriented single crystals subjected to 100 keV-Fe ion implantation. The corresponding profiles are given in figure 3(a-b).

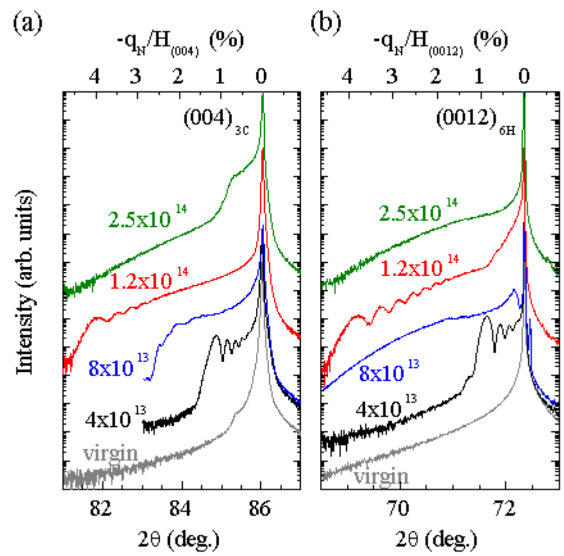


*Figure 3: θ-2θ scans recorded close to (004) of 3C-SiC (a) and close to (0012) of 6H-SiC (b) for increasing ion fluence.*

At low fluences, a damage peak is clearly visible at the low-angle side indicating the presence of a strain profile across the implanted region. The strain reaches a maximum value of 4% (tensile). Increasing the fluence result in a progressive amorphization of the implanted region. Further experiments (in particular [10*L*] diffuse scattering scans) are necessary in order to get a clear picture of the influence of ion implantation in terms of structural defects and of the stability of the 3C phase.

[1] A. Boulle, J. Aube, I. G. Galben-Sandulache, D. Chaussende, Appl. Phys. Lett. 94, 201904 1-3, 2009.

[2] A. Boulle, D. Dompoint, I. Galben-Sandulache, D. Chaussende, J. Appl. Cryst. 43, 867-875, 2010.